Tensile characteristics of Glass Fiber Composite to predict R-value of Tensile-Tensile Fatigue Test

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1 COMPOSITES

In the most general of terms, a composite is a material that consists of two or more constituent materials or phases. Fiber –reinforced composite materials consists of fibers of high strength and modulus embedded in or bonded to a matrix. In this form, both fibers and matrix retain their physical and chemical identities, yet they produce a combination of properties that cannot be achieved with either of constituents acting along. In this study FIBERS (E-GLASS) and EPOXY (LY556) are used.

2 TECHNIQUE TO MANUFACTUR COMPOSITES LAMINATES

Hand lay-up: First four plain woven fibers are cut to the required dimension of 250 mm length and 175mmwidth each.

OHP sheets on which the laminates are to be prepared are placed on a table. The Epoxy and required hardener are mixed and placed as a layer evenly on the OHP sheet and then a cut woven fiber is placed and a roller is rolled over the fiber after this again Epoxy mixture is placed over the prepared laminate and the process is repeated for all four woven fiber. After completing it another OHP sheet is placed over the completed laminate. And finally put a flat weight on it. Cure it for 4 to5 hours as per ASTM D3036 standard. Then by using compression machine, the cured laminate should be compressed for 10 minutes. Then take the laminate and cut it into required shape so called Dog Bone shape. Now the specimens are ready for tensile testing.

3 SPECIMEN:

As per ASTM D 3039/ D 3039 M-08, the specimens are prepared for testing.

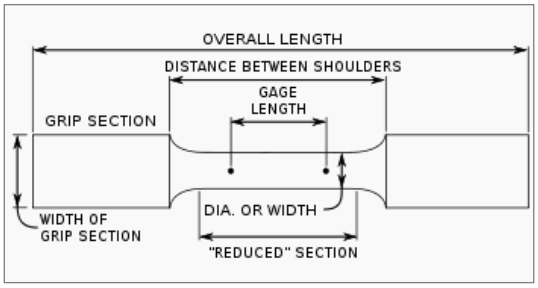

Figure 1. Schematic representation of terminologies of Dog Bone shape

Figure 2. Photograph of Dog Bone shape

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4 LAMINATE TYPE(0 °/90 °)$_4$:

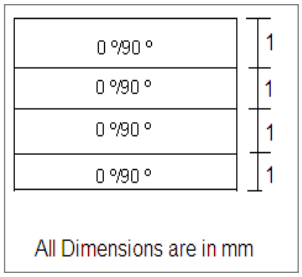

Figure 3. Schematic representation of Laminate 1

4.1 Weight of the Laminate W_L:

Weight of the laminate W_L = 280 g

Weight of fiber W_f = 200 g

Weight of matrix W_m = 80 g

4. 2 Weight of the specimen W_S:

Number of specimen = 7

Weight of the specimen W_S= 40 g

Weight of fiber W_f= 28.6 g

Weight of matrix W_m= 11.4 g

4. 3 Volume fraction of fiber and matrix:

Volume of fiber in a specimen VF=

mass of fiber/density of fiber

=28.6/2.6

=11 mm3

Volume of matrix in a specimen VM =

mass of matrix/ density of matrix

=11.4/1.218

=9.35 mm3

Total volume = 20.35mm3

Volume fraction of fiber , Vf =

volume of fiber / total volume

=11/20.35

=54%

Volume fraction of matrix , Vm=

volume of matrix / total volume

=9.35/20.35

=46%

5. LAMINATE TYPE 2(0°/90 ° //+45°/-45°)$_2$:

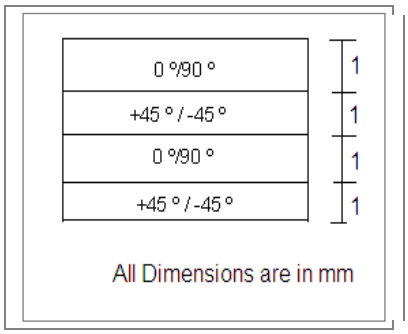

Figure 4. Schematic representation of Laminate 2

5.1 Weight of the Laminate:

Weight of fiber = 200 g

Weight of the laminate = 290 g

Weight of epoxy = 90 g

5.2 Weight of the specimen:

Number of specimen = 7

Weight of fiber = 28.6 g

Weight of the specimen = 41.4 g

Weight of epoxy = 12.8 g

5.3 Volume fraction of fiber and matrix:

Volume of fiber in a specimen = mass of fiber/density of fiber

=28.6/2.6

=11 mm3

Volume of matrix in a specimen = mass of matrix/ density of matrix

=12.8/1.218

=10.51 mm3

Total volume = 21.5mm3

Volume fraction of fiber Vf = volume of fiber / total volume

=11/21.5

=51.2%

Volume fraction of matrix Vm= volume of matrix / total volume

=10.51/21.5

=48.8%

6. TENSILE TESTING

First Tensile test should be conducted on specimens to find out the maximum strength of the laminate and from this strength value, the fatigue testing load will be found and this load will be applied on the specimen for the fatigue testing. This fatigue value will be lesser than the maximum strength of the specimen.

As per ASTM D 3039, the specimen known as dog bone shape subjected to tensile testing. Here two types of specimens are tested under the different orientation and volume fraction. According to ASTM D638 the tensile testing is done and the failure of laminate is fully breaking of the specimen. And the result is noted down.

7. TESTING SPECIMEN:

Dog bone shape of specimen is to be made from the cut specimen as per ASTM D3036

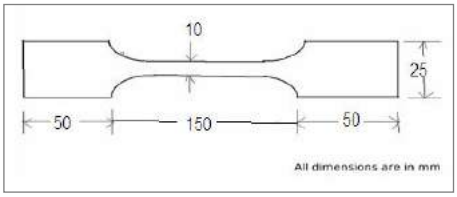

Figure 5. Schematic representation of Dog Bone shape dimension

8 RESULTS:

SPECIMEN 1(0 º/90 º)$_4$:

Table 1.Tensile Strength on Laminate 1

SAMPLE	WIDTH	THICKNESS mm	AREA mm2	BREAKING LOAD kN	TENSILE STRENGTH kN/mm2
1	14.6	4	58.4	10.4	0.18
2	14.8	4	59.2	11.5	0.19
3	14.7	4	58.8	11.1	0.19

SPECIMEN 2 (0º/90 º //+45º/-45º)$_2$:

Table 2.Tensile Strength on Laminate 2

SAMPLE	WIDTH	THICKNESS mm	AREA mm2	BREAKING LOAD kN	TENSILE STRENGTH kN/mm2
1	12.9	2.6	33.54	4.15	0.12
2	13.4	2.8	37.52	4.45	0.12
3	13.4	2.7	36.18	4.5	0.12

From the above tables, it is clear that the specimen type 1 is higher strength specimen type 2. Because the direction of fiber is along the load direction

9.CONCLUSION:

The specimens oriented as **(0 º/90 º)$_4$** posses more strength than the other. So it is selected to predict R-value for Tensile-Tensile Fatigue Test in future.

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